Guidelines for Environmental Health for Offshore Installations

Guidelines Addendum

Potable Water Management

Issue 1
September 2024

Acknowledgments

In preparing and publishing this document, OEUK gratefully acknowledges the contribution of members of the work group, namely:

- Andrew Russell
- Audrey Laing
- Carolyn Smith
- Graham Furnace
- John Musgrave
- Julie Hart
- Laura Beaton
- Mark Plummer
- Melanie Steel
- Neil Grace
- Neill Crone
- Nigel Mandley
- Russell Caldwell
- Sasha Crookston
- Stephen Clarke
- Steve Clark

ISBN: 1 903 004 73 2
PUBLISHED BY OEUK

London Office:

1st Floor, Paternoster House, 65 St Paul's Churchyard, London, EC4M 8AB
Tel: 020 7802 2400 Fax: 020 7802 2401

Aberdeen Office:

4th Floor, Annan House, 33-35 Palmerston Road, Aberdeen, AB11 5QP
Tel: 01224 577250

info@oeuk.org.uk

www.oeuk.org.uk

Contents

List of Abbreviations

Abbreviations	Definitions
ATP	Adenosine tri-phosphate
BMA	British Medical Association
CFU	Colony-Forming Units
CIBSE	Chartered Institute of Building Services Engineers
COSHH	Control of Substances Hazardous to Health
CPA	Clinical Pathology Accreditation
CWST	Cold water storage tank
DBP	Disinfection By-Product
DCR	Offshore Installations and Wells (Design and Construction, Etc.) Regulations 1996
DESNZ	Department for Energy Security and Net Zero
DPD	diethyl-p-phenylenediamine
DWI	Drinking Water Inspectorate
EPDM	Ethylene propylene diene-terpolymer
EPP	Exposure Prone Environment
HPA	Health Protection Agency
HSE	Health & Safety Executive
HVAC	Heating, Ventilation and Air Conditioning
ICP/MS	Inductively coupled plasma mass spectrometry
MAR	Offshore Installations and Pipelines Works (Management and Administration) Regulations
MPN	Most Probable Number
NAI	Normally attended installations
NUI	Normally Unmanned Installations
NTU	Nephelometric Turbidity Unit
NWC	National Water Council
OFAR	Offshore Installations and Pipeline Works (First-Aid) Regulations
OIM	Offshore Installation Manager
OSDR	Offshore Safety Directive Regulator
PHLS	Public Health Laboratory Service
POB	Personnel On Board
PPE	Personal Protective Equipment

Abbreviations	Definitions
PPM	Parts per Million
qPCR	quantitative Polymerase Chain Reaction
RIDDOR	Reporting of Injuries, Disease and Dangerous Occurrences Regulations
ROGI	Report of an Oil and Gas Incident
SDS	Safety Data Sheet
SEHD	Scottish Executive Health Department
TMV	Thermostatic Mixing Valve
TVC	Total Viable Count
UKAS	United Kingdom Accreditation Service
UV	Ultraviolet
VBNC	Viable but non-culturable
WHO	World Health Organisation
WRAS	Water Regulations Advisory Scheme
WSOC	Written Scheme of Control

Introduction

This document has been written by an OEUK member expert Task Finish Group in response to a request from the Operational Health and Hygiene Technical Group, for more relevant and detailed guidance on the subject of offshore potable water management.

This is an addendum to the OEUK Guidelines for Environmental Health for Offshore Installations. It has initially been published as an addendum to the Guidelines with the intent to include them in the next review and update of the Guidelines.

This document should be read in conjunction with the OEUK Guidelines for Environmental Health for Offshore Installations.

1 Potable Water Management

1.1 Introduction

Drinking water must be ‘wholesome’, defined in law by standards in terms of its quality, as measured by standards for the concentration of chemical and biological contaminants and by some physical properties such as its clarity. Legal standards in the UK are those set out in the EU Drinking Water Directive, which concerns the quality of water intended for human consumption and to protect human health from adverse effects of any contamination of water intended for human consumption by ensuring that it is wholesome and clean.

The Offshore Installations and Pipeline Works (Management and Administration) Regulations 1995, (MAR) Regulations 17 and 18, apply in regard to the supply and quality of drinking water offshore:

> **17**. The duty holder shall ensure that—
>
> (a)an adequate supply of clean, wholesome drinking water is available at suitable locations on the offshore installation; and
>
> (b)such locations are clearly marked to show that drinking water is there.
>
> **18**. The duty holder shall ensure that all provisions for consumption by persons on the offshore installation are fit for human consumption, palatable and of good quality.

Although the relevant onshore water regulations (The Water Supply (Water Quality) Regulations 2018, and The Water Supplies (Water Quality) (Scotland) Regulations 2014) do not apply offshore, the standard defined by onshore legislation and guidance is the minimum that would be expected under MAR. The British Standard, BS 8680:2020 Water Quality, is also a useful source of information.

As well as meeting the 'wholesome' standards, it is also important that water is acceptable to the consumer in terms of its colour, smell, and taste even if the presence of one or more of these characteristics does not present a risk to health. The water must therefore be free from any objectionable taste or odour. If the odour of chlorine is excessive, the quantity present should be assessed and its reduction to an acceptable level may then be necessary.

The above water regulations provide standards to protect consumers from the risk of ingesting microbiological or chemical materials at levels that will cause ill health. However, the pneumonia-like disease called 'Legionnaires' Disease' normally arises by breathing in aerosols containing high levels of *Legionella* bacteria. The Control of Substances Hazardous to Health Regulations 2002 (as amended) and the HSE Approved Code of Practice L8 provide the legislation and standards covering this risk. There is a requirement to identify and assess sources of risk from *Legionella*, take steps to prevent or control the risk by putting adequate controls in place and maintain them. In carrying out a risk assessment on a water system, it is efficient to take a holistic approach and consider all water related microbiological risks at the same time.

Potable water systems offshore are extremely important from a welfare perspective for domestic purposes such as hand washing, cooking, drinking, and washing. Therefore, it is crucial to manage these systems effectively to prevent ill health of the those on board an installation but also, disruptions to a wholesome supply of potable water can cause workforce welfare issues which may result in reputational damage for the duty holder and ultimately the requirement to down-man the installation.

Special attention needs to be given to the provision of potable water on NUIs where there may be several weeks between visits.

While this addendum to the OEUK Guidelines for Environmental Health for Offshore Installations looks to provide practical guidance for the effective management and control of potable water systems on an offshore installation, The Marine Safety Forum has produced guidance for Delivering Quality Potable Water to Offshore Installations.

It should be noted when reading guidance, predominantly produced for onshore water systems, that offshore water systems have some significant differences to most onshore systems.

- Onshore systems in the main are fed directly from the municipal suppliers guaranteeing quality of water
- Offshore systems are fed either from water produced offshore or from water delivered via supply vessels and the quality of water is not guaranteed by municipal supplier
- Offshore cold water is always stored and often for longer than would be advised
- Onshore, where required some hot water system temperatures are limited to <42ºC to ensure no possibility of scalding vulnerable individuals
- Offshore, assuming appropriate signage/measures are in place, has no requirement to limit hot water temperature

1.2 Design and Construction

There are no published design guides for potable water systems offshore. However, there are onshore standards available that should be used when designing a new potable water system for offshore, or replacing, repairing, or maintaining, an existing system. The most significant are:

- The Water Fittings Regulations (or Byelaws 2014 in Scotland) that list the standards which fittings must meet. The Water Supply (Water Fittings) Regulations 1999, The Water Supply (Water Fittings) (Scotland) Byelaws 2014 and the Water Supply (Water Fittings) Regulations (Northern Ireland) 2009
- The Water Fittings and Materials Directory published by the Water Regulations Advisory Scheme (WRAS), which gives up-to-date details of a wide range of items that have been tested and proved to comply

1. Many companies all over the world construct forgeries of approved materials and attempt to sell as genuine parts. Beware when purchasing and ensure that materials are purchased from an approved supplier.

2. BS 8558:2015 Guide to the design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages

Whilst these regulations and guidelines do not apply offshore, they should be taken into account when designing potable water systems to ensure safe design and operation.

Among the most important design features for potable water systems are the following:

- The materials of construction should not support microbial growth and be immune to, or protected from, corrosion by galvanic action
- Any coatings used in contact with potable water should be approved for use i.e. solvent free epoxy coating for cold water storage tanks that has been WRAS approved
- The materials of construction should not have the potential to provide a source of toxic substances to the system, nor should it provide the potential for causing colour or odour changes in the water
- Volumes where water can remain standing for considerable periods (e.g. dead legs) should be avoided for example have inlet and outlets on potable water tanks opposed to ensure flow of water across the tank and use flow through expansion vessels
- Access for maintenance, and testing should be provided (accessible inspection hatch on lid of tank to facilitate annual inspection without need to drain the tank)
- Any pipe supplying cold water for domestic purposes to any tap must be so installed that, so far as is reasonably practicable, the water is not warmed above 20°C
- Long lengths of hot water pipework should be fitted with secondary return pipework to circulate the hot water and achieve temperatures >50°C within 1 minute of opening an outlet
- Hot water return pumps should be sized so that all hot water return pipework is circulating at a temperature >50°C and balancing valves should be fitted if any sections of return pipework are not circulating
- Any thermostatic mixing valves for hand wash at around 41°C should be fitted as close to the terminal outlet as possible (maximum 2 metres' length of blended pipework allowed). Where possible TMV's should be avoided as the blended water line is prone to bacterial colonisation
- Self-desiccating/self-cleaning showerheads should not be fitted as they encourage growth of bacteria and biofilm formation
- Suitable backflow protection devices should be fitted to any potable water connection to a non-potable water system in relation to the non-potable water systems fluid category. Refer to HSE Offshore Information Sheet No. 4/2010: "Managing the segregation and isolation of potable water systems on offshore installations"

- Any backflow prevention valve should be serviced annually, by an approved provider, to confirm it is in the correct operational condition in line with the manufacturer's guidance

The system should be of a sound ergonomic design so that anyone working on it whether it be for maintenance, or operational purposes are not subjected to unnecessary physical strain as this can result in the necessary works not being completed properly.

When considering design of a potable water system on an offshore asset you must ensure that there is always an adequate supply of hot and cold water on board which will supply all outlets (taps, showers, toilets, washing machines, mechanical equipment which uses water etc.) while ensuring that an excessive amount is not being stored. All parts of the system should be designed so as to minimize stagnation of water by always ensuring adequate flow.

The following is a breakdown of the potable water system and what areas to consider with design and construction.

1.2.1 Sourcing Potable Water

Consideration should be given to how the potable water will be bunkered, specifically whether it will be in the form of supply vessel deliveries only or include the use of water makers in the form of Reverse Osmosis or Evaporative Condensers. If a supply vessel is to be used it is important to carry out a supply chain audit to ensure the quality of the water to the end user.

1.2.2 Cold Water Storage Tanks

Cold water storage tanks should be installed in an appropriate location so that access is available for inspection, monitoring, and maintenance purposes. An appropriately designed tank will have the following features to ensure temperature is maintained, stagnation is avoided, and quality of water being stored does not deteriorate quickly:

- Inlet and outlet at opposing ends to achieve suitable flow and avoid stagnation
- A drain at the bottom to fully empty tank if required
- A suitable inspection hatch installed on the top of the tank which is easily accessible for removal and potential entry into tank for inspection or cleaning purposes
- A screened vent to prevent ingress of contaminants and to prevent any condensation gathering on the underside of the tank lid, which can provide a breeding ground for bacteria
- Insulation to reduce thermal transfer
- Internal surfaces of tanks treated with coating to prevent corrosion or contamination
- Internals should have as few braces and compartments as possible as this will make draining, inspection, and cleaning much easier. Note: Tanks should not carry any other fluid types within them, even in double skinned piping

1.2.3 Calorifiers

Where possible, suitable calorifiers should be installed to provide hot water to the installation for domestic use. These should be of an appropriate size to supply all cabins on board and have the following features to maintain quality of water being supplied:

- Positioned vertical as horizontal positioning can create build-up of deposits
- Drain situated on the very bottom to allow appropriate flushing
- Shunt pumps which will circulate water top to bottom to prevent stratification and keep a good temperature throughout vessel
- Insulation to reduce heat loss
- Hatch to allow for inspection and cleaning if necessary
- Temperature gauges for monitoring of outgoing and return temperatures. Outgoing temp >60°C and return temp of >50°C
- Installed in an area that is easy to access, operate manual valves and monitor gauges
- Calorifiers should be sized to deliver sufficient capacity of hot water even at times of high demand, without a drop in temperature

1.2.4 Distribution Pipework

- Distribution pipework should always be made of WRAS approved material and installed so to minimize the likelihood of any thermal transfer or potential contamination
- Dissimilar metals should not be in direct contact to prevent galvanic corrosion. Insulating all pipework is also appropriate to control temperatures
- High usage outlets should be fitted at the ends of distribution lines to ensure good water flow rates through the main headers
- Pipework diameters should be appropriately sized to avoid sections of slow flowing water.
- There should be good access provided to all pipework fittings to allow for servicing and the distribution pipework and all associated fittings should be suitably labelled in accordance with BS1710
- Consideration should be given during design for circulation of cold-water system through use of flow splitters if long lengths of pipework is likely
- Installation of bypass lines on any water treatment unit should be avoided, if possible, to prevent formation of dead leg pipework and ensure critical control points cannot be circumvented
- Permanent crossover connections between supplies for redundancy should also be avoided so that dead legs are not created

1.2.5 Water Maintenance

It is good practice to have biocidal dosing between bunkering station and storage tank, so water is treated prior to being stored for consumption. Further treatment units can be installed to ensure that water remains at satisfactory treatment levels. You may need to consider the optimal dosing point or points if you use both Water Makers and are Bunkering.

1.3 Bunkering and Storage

These guidelines cover the delivery, storage, and use of potable water on the installation. However, operators should assure themselves that the same standards of hygiene and monitoring are applied to water produced offshore, and onshore at the point of loading water onto the supply vessels and that supply vessels themselves meet appropriate standards: Delivering Quality Potable Water to Offshore Installations Rev 03 -16 Jun 21

Hoses must be suitable for potable water and be made of ethylene propylene diene-terpolymer (EPDM) orange rubber certified bunkering hose and all fittings WRAS approved. Coupling on hoses used for potable water should be incompatible with couplings used with other transfer hoses. After use, they should be drained, to prevent the water residue becoming stagnant and being injected into the water tank with the next delivery of water.

A suitable disinfection/hose management method, is as follows:

i. Full strength flush of the hose overboard
ii. All connections locally disinfected before every use.
iii. Hoses should be replaced as manufacturer recommendations.

Offshore installations should only bunker potable water that has been stored on board the vessel for less than 14 days.

Prior to loading on the platform:

- the hoses are to be flushed at the full flush rate
- A sample taken from loaded water should be clear and should not exhibit abnormal odour, cloudiness, oil, free Chlorine, or temperature (if not ambient)
- Conductivity measurements should confirm absence of sea water contamination
- The water is only bunkered after it has been checked for these key parameters and the results are acceptable

On completion of bunkering, ensure water is chlorinated to maintain residual levels of free chlorine 0.2 - 1ppm, preferably maintained around 0.5ppm.

1.3.1 Bunkering Water

As discussed earlier, these guidelines cover the delivery, storage, and use of potable water on the Installation. Ensuring these same standards of hygiene and monitoring are applied across all areas of water management is key. It is the operator's responsibility to ensure the water is of sufficient quality to be used as potable supply. Therefore, the operator should ensure the loading and the transport of the water via the supply vessels are meeting the appropriate standards. This can easily be achieved by managing these steps with the Written Scheme of Control (WSOC), ensuring there is consistent communication, where the operator sees visibility of the testing regimes both onshore and onboard the supply vessels (this can be via document review, but good practice would be to have audits in the plan for verification both at the onshore bunkering facility and onboard the supply boats. This together with the required testing prior to bunkering onto the installation will provide confidence in the quality of the water.

Where bunkering is only used as an emergency scenario, where water is normally produced via water makers, it is important the hose and pipework system is left in a safe state. If the hoses are staying *in situ*, these should be disinfected and flushed and fully capped. The spare hose can be left in storage onboard ready to use when required, this reduces the chance of any potential contamination.

Previously treated water will probably require re-chlorination, as the free chlorine level is reduced over time, particularly during transportation. Most vessels do not treat the bunkered water with any chlorine during transport.

The maintenance of the potable water tanks and system should be in the planned maintenance and cleaning scheme.

Cold water storage tanks (CWST) must be internally inspected annually, and the condition detailed and recorded. Following the internal inspections, storage tanks may be brought back into normal service unless intervention i.e. entry into the storage tanks for cleaning and repair purposes has occurred. If an intervention has occurred, prior to the storage tanks being brought back into normal service the water system shall be disinfected. Good practice would be for water samples to be taken 48hrs post disinfection to confirm no system contamination has occurred during the intervention.

Guidance on condition checks for the internal and external inspection of CWST are:

- The tank lid should be closely fitted and in good condition
- The insect screen on the overflow and warning pipes and any vents should be intact and in good condition
- The thermal insulation should be in good condition so that it protects from extremes of temperature
- The water surface should be clean and free from any visible, significant contamination

1.4 Routine Treatment of Water Supplies

1.4.1 Methods

It is essential to treat all water, either from bunkers or desalination systems with a residual biocide. Any biocide used for drinking water (in the UK) must have The Biocidal Product Regulations 2001 – Part V approval. (suitable for use for the disinfection of drinking water for both humans and animals). Water containing a residual, maintenance dose level, of disinfectant, (dispersive biocide) will continue to have some antibacterial protection as the water moves around the distribution system. When using these methods to control *Legionella* including copper and silver ionisation and biocide treatments (eg chlorine dioxide), to ensure that they remain effective their application will need suitable assessment as part of the overall water treatment programme including proper installation, maintenance and monitoring.

Table 1: Water Treatment Methods

Treatment	Application	Effective Level	Benefit & Detraction
Sodium Hypochlorite	Automated injection or manual	0.2 – 1ppm	Most widely used treatment offshore due to its low cost, effectiveness, and ease of use. chemical that will maintain a residual level throughout a cold-water system. Does not penetrate biofilms and its effectiveness is dependent on water pH and temperature. Chemical has a short shelf life.
Calcium Hypochlorite	Manual addition	0.2 – 1ppm	Same limitations as Sodium Hypochlorite but has a longer shelf life
Chlorine Dioxide	Automated injection	0.1 – 0.5ppm	Most effective dispersive biocide, penetrates biofilm and can effectively clean pipework over time. This chemical is also active in the hot water systems and is not affected by pH.
Silver ion	Automated from silver ion generator or manual from powder or liquid	0.02 – 0.1ppm	Long lasting residual disinfection with no change to taste, smell, or colour of water. Very long shelf life. No disinfection by-products. No corrosive effect. Requires an electrode to be replaced periodically. Silver ion test kits are not cheap or very accurate.

Treatment	Application	Effective Level	Benefit & Detraction
UV	Flow through UV lamp	Based on UV transmittance and flow rate through chamber	Its primary disadvantage is the lack of residual disinfection. Less effective if water contains particulates or colour/turbidity. Quartz Sleeve requires periodic cleaning and UV lamp replaced when recommended run hours are up. Drinking Water Inspectorate recommends that UV units are validation tested.

Source: HSE L8 – Legionnaires Disease – The Control of Legionella bacteria in water systems.

Caution

Biocides are to be stored and handled following the manufacturers Safety Data Sheets (SDS) and a COSHH assessment must be carried out for whatever product is being used. The incorrect storage and/or handling of biocides can result in explosive reactions and gas release. For example, mixing of acid with Sodium Hypochlorite will be volatile and release chlorine gas, mixing of Calcium Hypochlorite with oil or petrol can result in an explosion.

1.4.2 Chlorine

Chlorine is added to drinking water as either sodium hypochlorite solution or dry calcium hypochlorite. Caution the storage and use of dry calcium hypochlorite offshore been known to result in fires. Added chlorine will react with organics and inorganics within the water (known as the chlorine demand of the water), the remaining chlorine that does not react is known as residual chlorine or free chlorine. Only free chlorine is available to interact with bacteria and kill them. Free chlorine is made up of two chemical species, one is hypochlorous acid that is effective at killing bacteria and the other is an ineffective chlorite ion. The ratio of hypochlorous acid to hypochlorite ion in water is determined by pH. At low pH (6–7), hypochlorous acid dominates, while at high pH (>8.5) the hypochlorite ion dominates. For this reason, control of pH when using water makers and the effective re-mineralisation of the produced water to prevent issues with pH bounce is important. (pH bounce is a cyclic and rapid change of the pH level between acidic and basic conditions of a solution.)

Chlorine does not penetrate biofilms and is weak against protozoa such as amoeba that are known to be host cells for *Legionella* bacteria. Therefore, super-chlorination (sometimes called shock chlorination or hyperchlorination) for treating instances of system colonisation by *Legionella* can often result in subsequent regrowth of the bacteria.

Another issue with chlorine is that it can react with organics, inorganics, and non-halogens in the water to form Disinfection By-Products (DBPs). The production of disinfection by-products matter because they can impact peoples health if consumed.

Chlorine should be stored in the original shipping containers or compatible containers and sited away from direct sunlight in a cool area. Long storage times should be avoided as chlorine has a short shelf life and feed rates may need to be adjusted to account for any losses in chlorine content during storage.

The amount of chlorine remaining must be measured e.g. using a comparator and indicator additives diethyl-p-phenylenediamine (DPD) tablets, which can be used to determine chlorine bromine, iodine, and other disinfectants in water, following the manufacturer's recommended method.

1.4.3 Chlorine Dioxide

It can penetrate biofilms better when compared with chlorine and its use as a biocide can be maintained over a wider pH range than can the use of chlorine. Chlorine dioxide is also effective at treating hot water systems as it will not be gassed off at higher temperatures like chlorine. Chlorine dioxide is usually generated on site from automated addition of two chemicals (precursor and activator) within a reaction chamber with metered proportional dosing into an injection point. DBPs are also formed with use of chlorine dioxide as a disinfectant. Levels of chlorite and chlorate should be tested in drinking water treated with chlorine dioxide to ensure they are both below 0.5mg/l. This guideline has been provisionally set by the WHO because use of chlorine dioxide as a disinfectant may result in the chlorite and chlorate guideline values being exceeded, and difficulties in meeting these guideline values must never be a reason for compromising adequate disinfection.

1.4.4 Silver Ionisation

Silver, or rather silver ions, is one of the oldest methods for deactivating bacteria. Silver is slow acting, but its result is long-term, preventing microbial growth for up to six months. Due to the long-lasting effect of silver ions, it is ideal for use in preservation of water systems during shut down periods. Silver ions do not change the taste, smell, or colour of the water. Silver ions in drinking water are not to be above 0.1mg/l and the silver ion generators are designed to impart a maximum of 0.05mg/l into flowing water. However, accurate monitoring for levels of ionic silver in distribution systems is difficult with field test kits being low in accuracy and expensive. Accurate monitoring for levels of silver can be achieved in laboratories by atomic absorption spectroscopy or the inductively coupled plasma method.

1.4.5 UV Treatment

Chlorine used to provide a residual chemical disinfectant should be dosed after UV filtration. UV irradiation will reduce chlorine concentrations in water and thus potentially impact on the maintenance of disinfectant residual concentrations in the supply. Compensating for the reduction in chlorine residuals by UV irradiation by elevating chlorine levels before UV treatment can adversely affect the performance of the UV filter as chlorine is a strong UV absorber. Water turbidity can adversely affect the performance of a UV unit and should be kept below 1 NTU. This can be achieved by having filtration installed upstream of the UV. The performance of UV reactors must be validated to demonstrate that they meet the intended performance criteria. Independent validation testing is commonly (but not always) undertaken by the manufacturers.

The effectiveness of UV disinfection processes must be verified. This will involve the continuous monitoring and recording of the conditions of operation at critical control points. Therefore, the following should be monitored and recorded as a minimum:

- Water flow, lamp status and UV dose rate within each reactor
- UV absorbance where a 'Calculated Dose' approach is employed
- Turbidities (representative of that within each UV reactor)
- Reactor cleaning, inspection, and maintenance; and
- Lamp operating times and dates of lamp replacement

Validation testing following recognised protocols accounts for the effects of lamp aging and other factors such as sleeve fouling. However, reduced UV outputs also occur upon initial lamp start-up and following power interruptions.

UV disinfection processes should not be by-passed, unless a process providing an equivalent, verifiable level of disinfection has been implemented and in continuous use. Installation of two parallel UV units can allow for maintenance and lamp replacement of one UV while the other is in service without interruption of the supply. Treatment unit bypass lines can act as dead legs that permit water to stagnate, and consideration should be given to removal of bypass lines to prevent their usage as these critical control points should not be circumvented.

1.4.6 Factors Affecting Treatment

Successful treatment depends on:

<u>The quality of water being treated</u>

To be effective, it is essential that all suspended matter be removed before disinfection, this can be done by filtration before loading into installation storage tanks.

<u>The correct dosage and contact time</u>

Depending on the selected biocide refer to the product data sheet for appropriate dosage rates. These should be stated in the site water safety plan.

<u>Mixing and distribution of the disinfecting agent</u>

Thorough mixing and distribution throughout the system of the disinfecting agent is essential. Automatic chlorination units are available that assist this. If manual addition is used, thorough distribution of the agent may be achieved by adding it to the water while it is running into the storage tanks. For stored bulk supplies, a method that ensures complete distribution of the agent throughout the tanks must be employed (e.g. recirculation pumps or by other means).

The pH, if using hypochlorite

Testing of the tank and extremities of the pipes must be carried out, and a periodic check of pH made to ensure that this is ideally no more than 7.5 and certainly below 8.0, as disinfection efficiency will be reduced at higher pHs.

Repeat Treatments

Monitoring of any biocide levels and pH (if using hypochlorite) are required to ensure they remain within effective levels throughout the entire system. This should be carried out daily at the tank(s) and at the furthest outlets, other outlets should be checked on a weekly rotational basis. This data should be recorded and trended for auditing purposes. Action should be taken to adjust biocide levels prior to falling out-with specification.

Monitoring of biocide levels should be carried out with an appropriate and calibrated test-kit, and a record of calibrations and quality control checks should be retained. Kits should be used, maintained and calibrated in accordance with manufacturer's instructions.

1.5 Disinfection of Potable Water Systems

Disinfection treatments are applicable to various bacteriological contaminations. This can be applicable to pathogenic bacteria such as *Legionella* or indicator organisms such as *E. coli,* Enterococci & Coliforms.

Potable water systems should be disinfected following any of the below scenarios:

1. During the initial commissioning of any new plant/equipment or additional accommodation.
2. If any plant or equipment has been offline for a prolonged period and is being brought back into use.
3. After any cleaning or manned entry for inspection or cleaning
4. After bacteriological results show it to be necessary (for example repeat high-level microbiological positives)
5. After a known contamination event
6. If there has been a case of Legionnaires Disease on the asset

Disinfection of hot water systems may also be required if calorifiers or hot water distribution pipework becomes colonised with bacteria or following inspection and cleaning of a calorifier. Disinfection of hot water systems can be achieved either by chemical treatment or pasteurisation.

1.5.1 Pasteurisation

If using heat to treat a calorifier after inspection and cleaning, prior to bringing the calorifier back into service, the vessel's thermostat should be increased to achieve an internal water storage temperature of >65°C. This should be checked on gauges fitted to the vessel (if accurate) and additionally with either surface temperature probe or infra-red temperature gun. Additionally, the calorifier drain should be opened to verify that the water at 65°C is present at the base of the vessel, or if fitted, the anti-stratification pump should be on. If treatment of the hot water flow and return pipework is also required, the isolation valves on the flow and return pipework should then be opened and the return pump switched on. The return pipework should be checked to verify circulation of hot water at 65°C for a period of 1 hour. Every hot water outlet throughout the system should then be flushed. Each tap and appliance should be run sequentially for at least 5 minutes at 65°C (but not necessarily at full flow) and then outlets run to pull the hot water through all pipework. This may need to be done level by level so that the demand on the calorifier is not too great and the stored water temperature does not drop below 65°C. The temperature achieved in storage, return, and at the various outlets should be recorded along with the contact times and this record held within the potable water log for any future auditing. This pasteurisation should be carried out in accordance with PD 855468:2015 – Flushing & Disinfections of Domestic Water Services. If necessary, cross over connections can be made to treat the cold-water distribution pipework in the same manner.

1.5.2 Chemical Disinfection

Only biocides appearing in the list of approved products published by the Drinking Water Inspectorate (DWI) should be used in contact with water. A CoSHH assessment is also required for these activities.

Caution

If carrying out a chemical treatment of the potable water system due to colonisation by *Legionella* bacteria and using a biofilm removing chemical such as Hydrogen Peroxide or Chlorine Dioxide, precautions should be taken. As a result of the chemical breaking down the biofilm that had developed within the system, there will be a period where even higher levels of *Legionella* bacteria will be released from system outlets (Taps/showers etc.). If these outlets are allowed to generate aerosols, there will be a risk of exposure to crew and especially personnel carrying out the flushing and testing. Therefore, consideration should be given to removal of showerheads and flushing outlets in a manner that reduces volume of aerosol generation (don't flush taps at full velocity).

1.5.2.1 Chlorine Dioxide

Chlorine dioxide has to be prepared onsite by the mixing of two chemicals. Always prepare chlorine dioxide in a well-ventilated environment and wear appropriate respiratory equipment. Following the manufacturer's instructions, mix the activator with the stabilised chlorine dioxide, and swirl gently. Replace the vented cap and allow the prepared solution to stand for 10 minutes before use.

Caution

> Use within one hour as any unused activated mixture has the potential to become explosive and should not be stored after use.

1.5.2.2 Stabilised Hydrogen Peroxide

A more suitable chemical for the disinfection of potable water systems are products that are based on stabilised Hydrogen Peroxide. These products help penetrate and remove biofilms, are not pH dependent, and will also work in hot water systems.

1.5.2.3 Sodium Hypochlorite (Part V registered)

Although being the most widely used biocide for routine bacterial control of potable water systems, the use of Sodium Hypochlorite for shock disinfection of potable water systems can sometimes be ineffective due to the following issues:

- Poor biocidal performance at higher pH values
- Sodium Hypochlorite does not penetrate or remove biofilms that can harbour bacteria and protect against chlorine attack
- Sodium Hypochlorite is quickly gassed off at higher water temperatures
- Product has a short shelf life and if stored for longer than 3 months (if opened) the % strength of the solution will have reduced

Suitable records of carrying out this disinfection should be retained including the high range chlorine testing carried out, pH testing and contact times.

1.6 Neutralising After Chlorination

If a consent for discharge of super chlorinated water has been approved by Department for Energy Security and Net Zero, super chlorinated water can be discharged directly overboard. If operating near coastal regions or in sensitive waters, the super chlorinated water will need to be neutralised prior to discharge.

Sodium Thiosulphate (neutraliser) can be purchased in either granular or liquid form. The granules should be dissolved in hot water prior to addition, to neutralise any super chlorinated water. If adding straight into cold water, the granules will not properly dissolve as the dissolution is an endothermic reaction that requires heat. Once the required weight of granules has been fully dissolved, the liquid can be added to the system, however agitation will be required to mix the neutraliser so that it reacts with the chlorine. This can be achieved in systems with recirculation and testing should be performed with an appropriate test kit to verify successful neutralisation. Care should be taken to avoid over neutralising tanks as this will prevent leaving the system with a suitably low-level residual chlorine level between (0.2- 1ppm) for protection. An indicator of over neutralising water is the formation of black particles at outlets as a result of corrosion products being reduced i.e. Iron to magnetite. Once successful neutralisation has been confirmed, the water can then be discharged overboard. It is not acceptable to return a neutralised potable water tank back into operation, this water must be discharged completely, and the tanks flushed to remove all traces of the chemical. The treated tank(s) should then be refilled leaving the normal low-level residual of free chlorine between 0.2 – 1 ppm.

Sodium thiosulphate must never be added before the expiry of the contact period otherwise disinfection will be incomplete. If potable water (and additives) is for offshore petroleum activities use i.e. operational oil and gas use, then they will need to be assessed regarding permitting. However, if the chemicals are used for potable water for food, water, accommodation uses, then they do not require to be captured on a permit as they are not regarded as 'offshore chemicals' as defined in The Offshore Chemical Regulations 2002.

Caution

never attempt to neutralise neat sodium hypochlorite with sodium thiosulphate as this is a hazardous volatile reaction and will release chlorine gas. Follow SDS sheets and never store acids with oxidising biocides.

Sodium Thiosulphate is not a DWI approved product and therefore should not be present in tanks used for potable water supply. If an accidental over-chlorination has occurred due to faulty equipment or miscalculation, the over chlorinated water should be drained, and the tank refilled or diluted to an acceptable level. The WHO has advised a maximum chlorination level of 5ppm in drinking water. This level of over chlorinated water will be highly unpalatable and supply of bottled water for drinking should be provided.

To confirm that any disinfection has been carried out successfully, bacteriological samples should be taken and tested to confirm removal of pathogens and/or absence of faecal indicator bacteria and low levels of TVC bacteria. This sampling should be carried out a few days after the disinfection has taken place so that any bacteria that have become dormant due to the disinfection yet are still viable are present in the laboratory results. If sampling to confirm eradication of any colonisation by *Legionella* bacteria, retesting should take place 48 hours after disinfection and continued at regular intervals until a period of historical data is collated to verify no regrowth is occurring.

1.6.1 Analysis Required

Table 2: Analysis Methods, Frequency, Sample Locations, Transition Times and Storage Temperatures

Column Heading	Analysis	Acceptable Limits	Frequency	Examples of Sample Location	Transition Times	Sample Storage Temperatures
Water Microbiology	Enterococci *E. coli* Coliforms	0 MPN 0 cfu/ml 0 cfu/ml	Quarterly	Galley/Tea points	24 hours	2 – 8°C

Column Heading	Analysis	Acceptable Limits	Frequency	Examples of Sample Location	Transition Times	Sample Storage Temperatures
	TVC@22°C TVC@37°C	300 at 27°C 100 at 37°C		Nearest & furthest cold outlets		
Legionella		<100cfu/L	Quarterly	Cabin Showers Galley Spray washers Dead legs Utility hoses Emergency Showers Calorifier drains	48 hours	Room Temperature
Hydrocarbon		<10µg/L	Six monthly	Cold water storage tanks	72 hours	2 – 8°C
Additional Microbiological Parameters			Quarterly	Dive chambers	24 hours	2 – 8°C

Source: HSE L8 – Legionnaires Disease – The Control of Legionella bacteria in water systems.

1.6.2 Taking Samples for Potable Water Analysis

The analysing laboratory should have third party accreditation (e.g. UKAS or CPA - Clinical Pathology Accreditation) and should be consulted as to their requirements for sampling. All samples should be collected in the appropriate sterile sample bottles; these will be supplied by the laboratory performing the analysis. The sampling point must be in good repair and must be representative of the supply being sampled. Appropriate places to sample are taps closest and furthest away from the supply tanks, a galley tap, the sick bay tap and a representative cabin. Sample locations should be identified as part of your water safety plan with consideration given to outlet use and risk present. Samples taken should be representative of the whole system. Avoid posting samples from offshore on Fridays unless they are guaranteed to arrive during laboratory opening hours, as otherwise sample processing can be delayed until the Monday as laboratories are generally closed at weekends.

1.6.2.1 Planning

Arrange sampling in a manner that ensures the delivery to the laboratory in the shortest time possible (see table 2 above). Ensure couriers are informed that these samples should be delivered as soon as possible.

If there is a delay in helicopter arrival, postpone taking the samples until it has been confirmed that the helicopter is flying. If samples have been taken and helicopter is cancelled ensure correct storage (see table 2) of the samples.

1.6.2.2 Routine Sampling

Prevention of sample contamination:

- Wear clean gloves
- Use a sterile wipe (e.g. alcohol wipe) or disinfectant spray solution, to disinfect the sample outlet thoroughly
- Do not touch the inside of the bottle or lid
- Do not lay lid down (as further contamination may occur)
- Sample from the water stream, try to avoid touching bottle to outlet
- Fill sampling bottle in one action do not rinse
- Do not overflow but fill to the neck of the bottle
- Do not allow liquid to contact any other surface prior to entering the bottle, (e.g. hand or hose or funnel)
- If potable water is being sampled for hydrocarbon contamination ensure hands and outlets are free of any grease, diesel, or other hydrocarbon

To take a water microbiology sample, ensure any aerators or fittings associated with the outlet are removed. The sample point should be cleaned & disinfected using alcohol spray/wipes. The tap should be flushed for 2-minutes or longer depending on the length of pipework prior to taking the sample.

To take a *Legionella* sample the outlet should be disinfected. The sample should then be taken straight away with no flushing carried out following BS 7592:2008 Sampling of *Legionella* Bacteria.

To take a chemical sample flush cold outlet for 2 minutes or longer depending on the length of pipework prior to taking the sample.

The following information should be supplied to the laboratory and the samples should be clearly labelled.

- Installation/vessel and sampling point
- Source of supply
- Method of treatment
- Temperature & biocide levels at site locations for microbiological samples
- Reasons for sampling and the analysis required
- Date and time collected
- Name of the person collecting the specimen
- Reporting contacts
- Purchase order number/ agreed billing method

1.6.2.3 Field Testing

On site test kits for microbiological analysis are available that can give rapid results for general water hygiene. Testing for Coliforms can be done with reagents that will produce a colour change, and further testing of the sample with a UV light will indicate if florescence is occurring and demonstrate that the coliforms are *E. Coli*. Another generic test for overall levels of bacterial activity in a water sample is the adenosine triphosphate (ATP) test. ATP is an energy molecule that is present in microbial cells and higher levels of ATP in water will correlate with increasing microbial activity. The use of these test kits should be limited to when working in remote locations and sampling and transport to an accredited laboratory is not practical.

1.6.3 Interpretation of Results

Many variables affect the absolute quantitative counts obtained by bacteriological testing. Arguably just as important as the absolute counts is the trend of results obtained from routine sampling over a period of at least a year. To obtain a valid assessment of the bacteriological counts obtained in an individual sample, the results should be compared not only with the recommended guidelines, but also with the past sampling record of that supply. It should be remembered that examination of a single sample can only indicate the conditions prevailing at the time of sampling and hence, for maximum value, bacteriological sampling must be repeated frequently. The following explains the significance of the test results.

1.6.3.1 *E. coli* & Enterococci:

E. coli & Enterococci represents human/animal enteric contamination and where an unsatisfactory result is confirmed, expert advice should be sought. The source of the contamination should be investigated, eliminated, and satisfactory repeat sampling results should then be obtained. If such a result is repeated subsequently, it may indicate continuing low-level contamination and require further investigation of the supply.

1.6.3.2 Coliforms:

Standard expected 0/100ml. No coliform organisms should be detectable in any sample of 100ml drinking water. When any coliforms are detected the disinfection process should be checked and a repeat sample taken from the same point which yielded the unsatisfactory result. Where an unsatisfactory result is confirmed, expert advice should be sought. With the advice obtained, action should be taken to determine the probable source of contamination. Satisfactory results obtained on repeat testing should not be regarded with complacency. If such a result is repeated subsequently, it may indicate continuing low-level contamination and require further investigation of the supply. Where coliform contamination persists, it may be necessary to increase the concentration of residual chlorine in the supply until the problem is overcome. It is suggested that advice on the method of chlorination should be obtained from a specialist.

1.6.3.3 Total Viable Count:

Standard to be expected - 'Marine Safety Forum guidelines or no abnormal change'. A TVC at 37°C of 100 cfu/ml and a TVC @ 22°C of 300 cfu/ml are recommended as upper limits at which investigation/disinfection should be carried out. Increasing levels of TVC's can be either through water stagnation, out of specification temperatures, or poor biocidal control. Action limits for TVC's should be incorporated into company standards and procedures so all assets know the standard and the action to take. To measure whether the results show no abnormal change, they should be trended and analysed with reference to the historical levels achievable. Any sudden marked increase in the total count over previously obtained results requires investigation and remedial action.

1.6.3.4 Chemical and hydrocarbon Analysis:

Water chemistry should be monitored and controlled to ensure that if too soft it will not be aggressive to system metals and result in leaching and heavy metal fails, or too hard and result in scaling. Every effort is to be made to ensure that potable water is protected against accidental contamination from hydrocarbons. The slightest trace can render the water undrinkable due to taint alone. Chemical analysis should be trended to pick up any changes over time, as this can give early warning of problems developing in the system.

1.7 Routine Water Management

This section confines itself to routine potable water management. It is not referring to normally unmanned installations or emergency disinfections. Water is either bunkered from supply vessels made onboard the installation with their own water makers, or a combination of both.

In all cases there are critical control points where the possibility of introducing or proliferating *Legionella* bacteria is possible. The installation needs a robust management system to identify where these critical control points are, how the risk will be controlled, evidence that they are being controlled and accurate records that can verify these controls were effective at a later date.

Although the risk of developing an illness through exposure offshore appears low, there is a foreseeable risk of exposure to *Legionella* since it is known to colonise the following locations that may be present on manned Installations:

- Hot and Cold-Water Systems
- Air Conditioning Units

1.8 Assessing and Managing Risk

Employers, and those with responsibilities for control of premises, including offshore installations are, in summary, required to:

- Identify and evaluate all the potential sources of risk and document these in a formal *Legionella* risk assessment. This risk assessment should be carried out by a competent person, trained in offshore water management. The risk assessment will also include the means by which the risk is to be eliminated, prevented, or controlled
- Following the *Legionella* risk assessment, the employer must formally appoint a named person who is responsible for managing the identified risks. They must have appropriate training and resources to fulfil this position. The first task will be to develop and record a

'Written Control Scheme' which will provide a working document on how the *Legionella* controls are to be implemented and managed on their site

- The nominated water management person may not be responsible for obtaining all the records required but they are responsible for ensuring that a robust record system is in place and being implemented and can be easily accessed should a water management problem arise on their site. Previous records are crucial to investigating what could have gone wrong and where, which will subsequently make it much easier to fix or manage

The assessment should be reviewed regularly (not more than 2-year interval) and specifically whenever there is reason to suspect it is no longer valid. An indication of when to review the assessment and what to consider should be recorded. This may result from, e.g.:

i. changes to the use of the installation in which the water system is installed
ii. changes to the water system or its use
iii. the availability of new information about risks or control measures
iv. the results of checks indicating that control measures are no longer effective
v. changes to key personnel
vi. a case of Legionnaires' Disease/legionellosis associated with the system

Expert advice may be sought to assess the risk, especially in relation to the condition, design and running maintenance of water systems offshore. It is also important to have an up-to-date schematic drawing of the system. Note - many systems are now old and have been changed and modified over the years leading to dead-legs etc. where bacteria may be harboured.

1.9 Controlling *Legionella*

In an offshore environment, control of *Legionella* should concentrate on preventing or limiting *Legionella* from entering the system as well as minimising its potential for growth and transfer.

It is possible to limit the growth of *Legionella* in the system by controlling three factors:

i. Temperature (particularly in storage)
ii. Use of biocides to limit the organic and inorganic deposits in the water system
iii. Avoiding stagnation of water throughout the system

Each of the controls requires monitoring to ensure their continuing effectiveness and HSE guidance provides information on appropriate monitoring regimes.

1.9.1 Temperature Parameters

Temperature monitoring, control and recording is the principal control for minimising *Legionella* growth:

Table 3: *Legionella* Temperature Parameters

Temperature in °C	Critical Parameter
Below 20	*Legionella* dormant (no growth)
20 – 50	Growth can proceed
35 – 46	Proposed optimum growth range
55	*Legionella* bacteria die within 6 hours
60	*Legionella* die within 32 minutes

Source: HSE L8 – Legionnaires Disease – The Control of Legionella bacteria in water systems.

Cold water should therefore be maintained below 20°C throughout the system. Hot water should be distributed at 60°C from the calorifiers and should circulate and return to the calorifier at no less than 50°C.

1.9.2 Use of Biocides

Organic and inorganic deposits are the nutrients which provide an ideal habitat for bacterial growth and biofilm formation. While biocides have a place in management, it has been demonstrated that oxidising biocides like chlorine are particularly ineffective against bacteria contained in a biofilm and serves to remind us that there are limitations to the use of biocides. See HSG 274 Part 1 - Info box 1.5: Biocide types and application, - as updated March 2024.

1.9.3 Avoiding Stagnation

The object here must be to avoid stagnation of the water system as much as possible. Dead legs should be minimised and removed if they cannot be flushed.

1.9.4 Cold Water Storage Systems and Tanks

The main control measures for a cold-water system are to ensure that the maximum temperature of water does not exceed 20°C anywhere within the system.

Little can be done about the location and design of the water tanks *in situ* now, but it may be possible to insulate them against the heat. A visual inspection of the inside and outside of the storage tanks needs to be undertaken annually. This could be achieved by utilising dedicated water-safe ROVs or borescopes, for example.

Access to the tank and good personal hygiene from those engaged in this task is key to ensuring contaminants are not introduced into the tank. All covers and fittings should be checked and renewed as necessary, with attention to overflow pipes being protected to prevent the ingress of birds, insects, and other material. Observation of the inner tank walls can be undertaken at this time to determine if there is a proliferation of biofilm, there is debris in the tank, or the tank coating is breaking down.

Good circulation of the water throughout the distribution system is also critical to avoid any stagnation within the pipework.

All showers should be run to waste once a week, to prevent dead legs from being formed. Certain types of washers on taps, showerheads and other fittings can support bacterial growth, and these should be checked and, if necessary, changed to National Water Council approved type washers. Dismantle, clean, and descale removable parts, heads, inserts and hoses (where fitted) of showers and spray taps quarterly, or as indicated by the rate of fouling or other risk factors. A small stock of spare showerheads held offshore will speed up the process.

1.9.5 Hot Water Supply Systems

Wherever possible, hot water should be stored at 60°C and distributed so that it reaches a temperature of 50°C within one minute at the furthest outlets. Temperature stratification and sedimentation in the calorifier are factors that can support bacterial growth and require control. Dead-legs and infrequently used pipes between a recirculating hot water supply and an outlet (e.g. a shower head) may be risk areas for microbiological growth because they may not be exposed to biocides and high temperatures.

1.10 Monitoring Control

Continual vigilance is required when monitoring control. The parameters checked should all have robust records which can be accessed via a Site Potable Water Management Logbook, also known as Potable Water Safety Plans. This and the maintenance management routines should ensure that all the necessary parameters for "wholesome" water are being monitored; it is not enough however just to monitor, you need to appreciate what the results mean and what you need to do to address the risks. The Water Management Logbook can be electronic or paper copy and must contain:

- Water bunkering records
- Water storage tank details
- Hot and cold temperature records at sentinel points and other significant outlets e.g. sick bay (monthly as a minimum, as per HSG 274 (This may be required to be done more frequently if identified within the site’s Legionella Risk Assessment/Written Scheme of Control)
- Levels of biocide at sentinel points and other significant outlets e.g. galley sink (conducted daily. Recommended levels between 0.2 to 1 ppm)
- Calorifiers distribution and return temperatures
- "Dead legs" and infrequently used outlets and their flushing regime.
- Shower head and shower hose cleaning (quarterly)
- Bacteriological and chemical analysis (quarterly) and *Legionella* sampling and analysis as prescribed in the Site Written Control Scheme

1.11 Microbiological Monitoring for *Legionella*

Current laboratory tests to confirm the presence of *Legionella* bacteria can take 10 days to process following the receipt of the sample at the laboratory. There are factors which may vary at the time of sampling that will affect the results. These include:

- The extent and location of biofouling relative to the sample point
- The "health" of the biofilm (is it firmly attached or sloughing off)
- The speed of flow of the water across the biofilm
- The presence of residual biocide in the sample

It is clear to see, with such variability that failure to detect *Legionella* in the sample is no grounds for relaxing controls. Nor should routine monitoring be used as a substitute for maintenance of the control strategies and measures identified in the risk assessment. However, the offshore operator has a duty to ensure a "wholesome" supply of water and to demonstrate this, so periodic sampling is required. How often will depend on the confidence the site has that their controls are robust and are being fully implemented. A sampling strategy needs to be developed for each site. If there is uncertainty regarding the controls, then monthly for 6 months seems reasonable then reduce to quarterly for the next six months and providing you have confidence in your management system then annually thereafter. This is of course flexible and there are many factors which may require this regime to be altered. This must all be documented in the Written Control Scheme which serves not only as a management plan but also the history (along with relevant records) of site potable water management.

1.12 Safety Aspects

For there to be a risk of *Legionella* infection, it is necessary to create and inhale aerosol droplets. As the elimination of aerosols is impractical, the control measures are based on preventing *Legionella* contamination and proliferation in the system.

Maintenance staff must ensure that they carry out cleansing and maintenance work without putting themselves at risk e.g. when removing algae, scale, and sludge. When draining down or flushing systems, care must be taken to prevent inhalation of potentially contaminating aerosols. Where necessary, suitable respiratory protection must be worn to protect against aerosols.

1.13 Contingency Planning

1.13.1 Storage Capacity

The installation should have sufficient storage capacity to provide 200 litres per person per day (20 m^3 per 100 persons per day). Long term storage is detrimental to the wholesomeness of drinking water. The total amount of storage must be sufficient to provide a buffer in the event of a water maker breakdown or poor weather preventing bunkering. Recommended contingency is the ability to cover 2 days’ supply for the number of persons on-board.

The failure of the potable water supply, for whatever reason, can have serious implications for the continued operation of the installation. Contingency plans should identify practical ways of reducing water use and controlling any risk to the health of the workforce until the water supply returns to normal.

A threat to the water supply can be caused by any of the following:

- Lack of water
- Waterborne disease
- Chemical contamination
- Malfunction in the disinfection process

The strategy for managing the emergency will have two elements, immediate actions to cope with the lack of water and recovery measures required to overcome the underlying cause of the lack of water.

Water Emergency Contingency Plans should be prepared for each installation. These should consist of:

Definition and method of identification of any of the four hazards to the water supply listed above.

- Immediate actions:
  - Reduction in use of potable water
  - Isolation of contaminated water
  - Use of alternative supplies for drinking
  - Down manning non-essential personnel if appropriate
- Recovery measures
- Return to Normal Operations

1.13.2 Definition of a Water Emergency

1.13.2.1 Lack of Water

For routine operations the water required is two days' supply of water per person, i.e. 400 litres, but this can be much reduced in **emergency** situations where the use of showers and laundries can be reduced/stopped. The minimum for an installation will vary according to the number of persons on board. However, the minimum required may be significantly larger if an installation is supplied by bunkering only and the weather forecast indicates that bunkering will not be possible for a number of days.

Defining the minimum amount of water required for continued operation is an important part of emergency preparedness. It identifies when measures are required to reduce water usage.

1.13.2.2 Waterborne Disease

An outbreak of waterborne disease, or its potential can only be identified by biological analysis or by diagnosis. This requires laboratory support and consultation between the installation medic and onshore medical support.

1.13.2.3 Chemical Contamination

This may be identified initially by taint (taste or odour) followed by chemical analysis.

1.13.2.4 Malfunction of the Disinfection Process

Primarily this is most likely to be caused by the addition of too much free chlorine. This will be identified by smell, complaints from personnel and water testing by the responsible person.

1.13.3 Managing a Water Emergency

An initial assessment of the impact on the water supply must be made to determine how much or how little water remains available for use. Is the entire supply affected or is it restricted to a single storage tank?

Once a water emergency has been declared immediate steps should be taken to isolate any contaminated water and reduce the rate of use of remaining potable water to allow time to implement remedial action. Washing of hands for catering staff is vital and must never be compromised, however potential water restrictions could include (not in any order of priority):

i. Laundry being done elsewhere or onshore
ii. Down man to essential personnel only
iii. Obtain bottled water for drinking water purposes
iv. Use disposable dishes, crockery, and cutlery
v. Restrict menu to cooked foods only

Note: Dishwashers and steamers heat cold water and may continue to be used depending on the bacterium. Laundry can be done at 90°C.

1.13.4 Recovery Measures

If caused by the failure of water production on the installation bunkering water should be instigated until the water maker is restored to full functionality. In all cases bunkered water will help both mitigate any water shortage and help with the recovery.

1.13.4.1 Waterborne Disease

The storage tanks and distribution system must be super-chlorinated to kill any pathogens in the system. Testing must confirm the absence of pathogenic bacteria before the affected supply is reinstated. Bunkered water may be used to purge the system of super-chlorinated water.

1.13.4.2 Chemical Contamination

Taint such as contamination by diesel fuel, can be difficult to remove and the potable water system will require repeated purging. The use of bunkered water can speed this process up. Odour and taste tests should be used with caution and must be confirmed by laboratory testing before reinstating the supply. Using a specialist contractor to carry out the cleaning process is advised dependent on the level of contamination.

1.13.4.3 Malfunction of the Disinfection Process

Principally this will be by over chlorinating the supply. The target for chlorinating the supply should be 0.5 mg/Litre (ppm) free chlorine. However, the WHO states that chlorine levels in potable water may be up to 5 mg/Litre (ppm).

b. If chlorine levels are greater than 1.0 ppm/Litre but less than 5.0ppm
   i. Inform personnel on board that water is not to be used
   ii. Review chlorination process.
   iii. Monitor daily to ensure chlorine levels are returning to normal
c. If chlorine levels are greater than 5 ppm/Litre
   i. Inform personnel on board that water is not to be used
   ii. Review the chlorination process.
   iii. Identify and isolate the tank(s) containing high chlorine levels
   iv. If possible, monitor daily and allow chlorine levels to decay. If this leads to a water shortage either discharge the affected tanks and resupply by bunkering or treat the affected tank(s) with Sodium Thiosulphate
   v. Reinstate tank(s) when chlorine levels fall below 5 ppm/Litre and continue to monitor daily until chlorine levels have returned to normal

1.13.5 Return to Normal Operations

Normal operations may be resumed once sufficient supply of wholesome water is available. That is there is a sufficient quantity of potable water free from chemical or microbiological contamination.

1.14 Training

Personnel involved in the operation and maintenance of the potable water system must receive training to provide technical knowledge and practical understanding of the principles, practices and processes involved in safely managing potable water offshore. As a minimum the training should include:

- Health Risks and *Legionella*
- Legislation, Standards and Regulation
- Potable Water Systems
- Potential Risks

- Control schemes.
- Treatment Options including Biocide Dosing and UV sterilisers.
- Bunkering, Sampling, Testing, and interpretation of results
- Monitoring and Inspection
- Maintenance and cleaning
- Record Keeping and Communication.

As a minimum, personnel likely to benefit from training include:

- Maintenance Personnel
- Medic
- HSE Advisor
- Facilities crew
- OIM

1.15 Offshore Water Management – Good Practice

1.15.1 Water Makers

Offshore assets producing their own drinking water will do so using one of two different technologies: Reverse Osmosis (RO) and Evaporation (Evap). Both are acceptable and both have advantages and disadvantages. Advantages and disadvantages will be site specific and independent advice should be sought prior to choosing method of use.

Historically, evap. was the main type of system used offshore, due mainly to its ability to utilise waste heat as an energy source for producing fresh water. Over recent years RO has become more common and better understood. However, the capital and operational costs of these are generally similar, as are their footprint requirements. In terms of water quality, including post treatments (i.e. re-addition of minerals), both can produce the exact quality of water the user requires. An engineering study can evaluate which system is best for the installation.

1.15.2 Management of Non-Potable Water Systems

The Regulations require operators to identify risks associated from offshore water systems (potable, technical, drilling and utility systems etc), namely from exposure to *Legionella* bacteria (the causative agent of legionellosis, including Legionnaires' Disease) and other water borne pathogens and to either prevent, or where this is not reasonably practicable, adequately control exposure to these biological agents. The HSE have identified gaps within this process in recent years, where there has been poor compliance in terms of managing the non-potable water systems offshore.

Any water system that has the potential to create an aerosol must be assessed, and controls put in place to minimise any risk. Specific consideration should be given to:

- Peripheral water tanks, e.g. annual inspections
- Industry best practice, being applied to both potable and technical (utility/drill) water systems

- Poor fire water tank management, e.g. water checking, dosing, and sampling prior to high pressure jet washing
- Poor control of mists ie. water for drilling and deck use
- Full scope of water systems being covered in risk assessment, i.e. no caveats. For example Duty Holder may consider some systems as negligible risk – but need to audit/understand the system before deciding this
- Front-end *Legionella* risk assessments being complete
- Internal misting systems being fully considered - often potable water, plant may be fed by sea water after the initial potable water charge. Salinity may not be a sufficient biocide if *Legionella* is in a dormant/VBNC state
- Offshore water systems may not be deemed as critical to routine operations, and therefore, corrective actions become superseded and buried under systems with a higher priority rating

1.15.3 Management of Safety Showers

If incorrectly connected and fed from the potable system, the main risk from safety showers will be from back flow cross contamination. This risk is eliminated by fitting the appropriate control valve or by detaching the shower system completely from the potable system.

There may also be risk when testing the shower for operational purposes. When doing so aerosol production should be minimised as much as possible and appropriate PPE used by operator.

Actions associated with controlling *Legionella* risk should never compromise the operation and functionality of the safety shower.

Safety showers come in various types and designs but often combine the risk of stagnating bodies of water which then, by design, disperse droplets upon use. Mains-fed systems both internal and external predominantly carry the same risks as domestic showers and can be managed similarly (flushing, cleaning, disinfection etc.). Systems at highest risk include small header tanks whose temperatures can fluctuate greatly.

European Standard EN 15154 requires water delivered by emergency safety equipment to be tepid, between 15-37°C (ideally between 20-25°C) . A balance is required between maintaining a cool enough temperature to prevent *Legionella* proliferation, but warm enough to be an effective decontamination – cold water shock may make the casualty pull away from under the shower.

Ideally the water temperature for emergency showers would be no higher than 20°C unless a higher temperature is required by a specific chemical, such as for example ammonia, which require a set temperature of 25°C to 30°C to mitigate burns. Otherwise increased flushing regimes will be required.

Whilst the priority must always be the provision of emergency response capability there are a number of considerations and actions that can be taken to try and manage or minimise risk, such as:

- Avoidance of static header tanks by using directly plumbed in systems, though volume and flow demands need to be assessed and met

- Reducing the volume of the header tank or in combination with a mains-fed top up system to manage supply demands
- Ensuring routine tank inspection, including dosing of biocides
- Protecting against thermal gain by insulating, or protecting against solar gain
- Regular flushing of header tanks and associated pipework, note that pipework alone can have long runs, so flushing needs to take into account also the volume of this supply pipework (consider the use of hoses, funnels, or buckets to collect or contain water released with an aim to prevent aerosol generation)
- checks of any thermoregulating equipment e.g. switch of trace heating during summer months
- Use of self-draining shower heads, reducing the number of environments available for *Legionella* to proliferate
- Consideration of alternative safety shower systems such as portable self-contained and sterilised units akin to a fire-extinguisher
- Regular biological testing of header tanks, such as by ATP analysis to indicate bacterial presence

Any maintenance or other activities which could affect the availability or function of the safety shower must be planned in with consideration of other activities taking place at the time and the likelihood of shower demand.

1.15.4 Troubleshooting

When water is out with specified parameters for chemical, micro, hydrocarbon, etc, there may be some quick troubleshooting mitigations.

- Minor pH fails – filling the sample bottle up to the top i.e. excluding air
- Mineralisation issues - RO water is not acidic enough to make remineralisation work. The granules only dissolve by surface area which can be too quick due to channel-forming and thus not enough surface contact. CO_2 pre-injection upstream of the reverse osmosis plant can acidify the water prior to remineralisation
- Water too hard it can cause scaling, so a balance is required. Scottish Water/WHO have no markers for hardness

Be aware of increasing biocide levels rather than investigating and managing temperature changes. Ensure that persons responsible for water management at site must act on expert recommendations rather than just logging out-of-spec results – i.e. referring to written scheme of control.

1.15.5 Testing protocols

Testing protocols may include field testing or external laboratory testing.

Field Testing

Field testing should be used within all water control schemes. Whether this includes temperature checks, chlorine measurements or microbiological analysis, the advantage is that these can be done on more locations within the site, at greater frequency, whenever necessary, repeated and do not rely on external input. Through their use sites will be able to demonstrate controls are in place and that the controls are having the required impact. In addition, field testing will identify fluctuations in effectiveness and efficiencies of control that can be adjusted for promptly avoiding potential losses of control.

Laboratory Testing

When *Legionella* testing is deemed necessary, as defined by regulatory guidance, the established method is the laboratory culture method which will require the use of an approved laboratory. Although rapid detection of *Legionella* bacteria – can be done by means of quantitative Polymerase Chain Reaction (qPCR) testing, which is suitable for use as a negative screening tool to rapidly rule out potential sources, for example, in an outbreak situation.

Whether field testing or laboratory testing, extreme care must be taken when taking the sample to ensure that it is representative and remains so prior to the actual testing taking place. In some cases, full testing arrays should be completed to create a cumulative picture. Consideration should also be given to the cumulative effects of out-of-spec test results.

1.15.6 Managing chloraminated water

There are a number of issues around potential water quality and risk that are being brought about through the use of chloraminated water and how it is managed offshore. If any issue arises seek advice through your water management consultant.

The operator will need to demonstrate that water treatment programmes are working within the established guidelines and are effective in controlling *Legionella* bacteria in water systems.

Chloramines are added to some mains water by Scottish Water (this is also a popular technique in other countries). There is some evidence that for drinking water disinfection purposes, chloramination provides a longer lasting residual disinfectant within the distribution system.

Chloramines are normally produced by adding ammonia to chlorinated water, forming inorganic chloramines. Monochloramine is the most biocidally-active chloramine compound.

1.15.7 Managing NUI's

By their inherent design Normally Unmanned Installations (NUI's) where workers may not be present for prolonged periods of time will not be able to achieve standard water controls (daily chlorine / temperature tests for example), therefore a pragmatic but risk-based approach needs to be taken and documented.

Written control schemes and risk assessments need to consider this intermittent attendance and the risk that prolonged absence brings. Arrival & departure checklists, realistic flushing, dosing, and testing regimes and good record keeping are prime considerations.

Where at all possible a NUI platform can operate without a potable water system this should be considered. This may require the transport of bottled drinking water or the inclusion of hot and cold-water stations that are again supplied from portable water containers at each trip.

For NUI's where no overnight stays are planned, there should be adequate welfare facilities for the number of workers likely to be present. Water provision should be managed on a risk-based approach to the level of manning planned and there should be categorisation of its use (Potable/Service/Technical). NUI's with no planned overnight stays must consider simplifying the system by reducing or eliminating the high-risk components, e.g. showers. Where planned overnight stays are required, the arrangements whilst manned should be in line with those required for NAI's (with particular attention on high-risk components and their management between manned periods).

Legionella risks:

- Use of antimicrobial cartridges, ionisation beads and intermediate bulk containers/tanks
- Tank emptying and cleaning – only used when water not being consumed
- Tank shelf-life
- Container/tank management – audit of the third-party vendor onshore
- Good practice options and technologies for use on NUIs

1.15.8 Competence & Training

The Regulations require employers to take reasonable steps to ensure that any control measures are properly used and applied. They require employees to make full and proper use of those control measures. Employers are also required to have arrangements in place for the management of health and safety, to have access to competent health and safety advice and to provide employees with suitable and sufficient information, instruction, and training.

Appoint a competent person or persons to help undertake the measures needed to comply with the requirements in COSHH. The appointed competent person should have sufficient authority, competence, and knowledge of the installation to ensure that all operational procedures are carried out in a timely and effective manner. Where the duty holder does not employ anyone with the necessary competence, they may need to appoint people from outside the organisation. In such circumstances, they should take all reasonable steps to ensure the competence of those carrying out work who are not under their direct control and that responsibilities and lines of communication are properly established and clearly laid down.

Those appointed to carry out the risk assessment and draw up and implement precautionary measures should have such ability, experience, instruction, information, training, and resources to enable them to carry out their tasks competently and safely.

Consistency of training and practical observation of competence is key including visual audit of method statements being followed correctly.

There should be a more advanced training for people who have been appointed as the *Legionella* responsible person, their deputy or the statutory duty holder. These roles typically have significant control over and responsibility for the management of *Legionella* in the workplace, in accordance the Health and Safety Executives ACOP L8, and Health and Safety Guidance HSG274 Parts 2 and 3.

Typically, candidates will have management responsibility for the day-to-day control of *Legionella* risks, the safe storage of water and safe operation of water systems under their control. The specific roles are stated in HSE's Technical Guidance – HSG 274.

Training for others is normally undertaken offshore via specific computer-based training (CBT), which normally last 1 - 2 hours and give a high-level overview of the hazards, risks, and controls.

1.15.9 Written Control Scheme

The written control scheme (WCS) sets out how controls are to be implemented and the organisational arrangements to ensure these are, and remain, effective. It is likely to comprise (or signpost to) system plans/schematics, the water treatment programme, cleaning/disinfection procedures, inspection, and monitoring (temperatures) regimes. It should clearly describe the correct operation of the system, including shutdown procedures, operating cycles, maintenance frequencies and actions to deal with matters of concern, e.g. breakdowns, abnormal/unexpected test results and/or visual fouling/contamination.

An effective WCS should be well-ordered and easy to navigate to enable the operator to check that the correct procedures are being followed and facilitate monitoring review. A template giving suggested headings and structure is given in HSG274 Part 2. An effective WCS will usually be one that has been jointly developed with technical and practical input from competent service provider(s). The WCS should also reflect the findings of the risk assessments.

The WSC is a live document and should be used to enhance the audit, verification, and review of the system as a whole. As the HSE set out, it must be a written scheme, a document that can be picked up and used as an *aide memoire* for inspection and auditing of the system. A record to confirm this has taken place, who was involved and what actions where required would be deemed good practice.

Monitoring records for potable water should demonstrate:

- bunkered water contains biocide with a concentration of 0.2–1.0 ppm. Previously treated water will probably require re-chlorination, as the free chlorine level is reduced over time, particularly during transportation. On completion of bunkering ensure water is chlorinated to maintain residual levels of free chlorine 0.2–1.0ppm, preferably maintained around 0.5ppm
- daily: biocide levels in accommodation (at least two samples) are 0.2–1.0 ppm
- weekly: little/unused outlets flushed. Exterior of bottled water dispensers, including the dispensing tap are cleaned and disinfected
- monthly: water temperatures at sentinel taps are (cold – <20 °C after 2 minutes; hot – >50°C within 1 minute)
- monthly: calorifier outgoing and return water temperatures are (flow at >60°C and return at least >50°C)

- at least annually, open the drain valves of the calorifiers and have any debris in the base flushed to waste, inspected for clarity, quantity of debris and temperature. The frequency may require to be increased as indicated by the findings
- annually: cold water storage temperatures are (<20ºC)
- quarterly: shower heads and hoses are cleaned and disinfected
- quarterly: the internals of bottled water dispensers are cleaned and disinfected
- quarterly: bacteriological analysis is carried out
- quarterly: chemical analysis is carried out
- annually: visual inspection of hot and cold-water storage tanks is completed
- microbiological monitoring for *Legionella* bacteria is carried out (in accordance with L8 *Legionella* ACOP)

BS 8680:2020 gives recommendations and guidance for the development of a water safety plan (WSP) for all types of premises and undertakings with water systems which can pose a risk to those exposed, either from the water itself, aerosols derived from it or the surrounding environment.

1.15.10 Management of Change

Management of Change (MoC) is a systematic approach to dealing with organisational change. The primary objective of MoC is to ensure the safety of workers during critical transition periods. MoC is a formal process of documenting, assessing, approving, and implementing change and should be initiated when there are any planned significant physical, operational or personnel changes which may pose new health and safety risks. Consideration should be made to the revalidation of Legionella risk assessments and WCS as part of the MoC process to ensure both remain representative and effective.

1.15.11 Data management and interpretation

A good water management control scheme will include measurements of system parameters ensuring controls are in place and that controls are effective. This could include temperature, chlorine, bacteria etc. By tracking and trending these matrices over time a better understanding of the system is gained. For example, seasonal changes, effects of fluctuation in POB can be defined and adapted to. There are many benefits to efficiencies and effectiveness of control schemes by tracking, trending and comparing data. The most important of these would be to identify changes in the system that could result in loss of control. By identifying these changes early through data collation controls can be adjusted and problems prevented.

Appendices

A References

Note: All legislation and associated guidance or approved codes of practice are available online (refer to useful websites below)

1. The Health and Safety at Work etc. Act 1974 (Application Outside Great Britain) Order 2001
2. The Management of Health and Safety at Work Regulations, 1999
3. The Offshore Installations and Pipeline Works (Management and Administration) Regulations 1995 and associated Guidance on the Regulations, L70
4. OEUK Guidelines for Environmental Health for Offshore Installations
5. Offshore Installations and Wells (Design and Construction, etc.) Regulations 1996 and associated Guidance on the Regulations, L85
6. Offshore Installations (Prevention of Fire and Explosion, and Emergency Response) Regulations 1995 and the associated Approved Code of Practice and guidance (L65)
7. Offshore Safety Directive Regulator (OSDR) Operations Notice 82 (Revised) Guidance on the Provision of Accommodation on Offshore Installations
8. EU Drinking Water Directive
9. The Water Supply (Water Quality) Regulations 2018
10. The Water Supply (Water Quality) (Scotland) Regulations 2014
11. The Control of Substances Hazardous to Health Regulations 2002 (as amended)
12. HSE Approved Code of Practice L8 - The control of legionella bacteria in water systems
13. Marine Safety Forum 'Delivering Quality Potable Water to Offshore Installations'
14. Control of Substances Hazardous to Health Regulations (COSHH) 2002 (as amended)
15. The Water Supply (Water Fittings) Regulations 1999
16. The Water Supply (Water Fittings) (Scotland) Byelaws 2014
17. The Water Supply (Water Fittings) Regulations (Northern Ireland) 2009
18. The Water Fittings and Materials Directory published by the Water Regulations Advisory Scheme (WRAS)
19. BS 8558:2015 Guide to the design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages.
20. Offshore Information Sheet No. 4/2010: "Managing the segregation and isolation of potable water systems on offshore installations".
21. BS 1710 Pipes and Ducts Labelling
22. BS 7592: 2008 Sampling for *Legionella* Bacteria
23. BS 8680:2020 Water quality – Water safety plans – Code of Practice
24. PD 855468:2015 – Flushing & Disinfections of Domestic Water Services
25. The Offshore Chemical Regulations 2002
26. National Water Council
27. Health and Safety Guidance HSG 274 (as updated)
28. Guidance should link to HSE Inspection Guide on Written Scheme of Control - The Offshore Water Management Inspection Guide
29. The Biocidal Products Regulations 2001 (legislation.gov.uk)
30. Drinking Water Inspectorate - List of approved products for use in public water supply in the UK

OEUK.org.uk/guidelines

Offshore Energies UK Guidelines
Member companies dedicate specialist resources and technical expertise in developing these guidelines with OEUK with a commitment to work together, continually reviewing and improving the performance of all offshore operations.

Guidelines are free for our members and can be purchased by non-members.

OEUK.org.uk

info@OEUK.org.uk

@OEUK_

Offshore Energies UK